BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg
BG PULSE JOURNAL

HYGIENIC ASSESSMENT OF INDOOR AIR VENTILATION AND VENTILATION SYSTEMS

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doi:https://doi.org/10.5281/zenodo.23493792

Abstract: Indoor air quality is a major determinant of human health because modern populations spend most of their daily lives in enclosed spaces. Ventilation systems play an essential role in maintaining acceptable microclimatic conditions by regulating temperature, humidity, air velocity, and contaminant concentrations. This article evaluates the hygienic significance of ventilation systems and analyzes criteria used to assess their effectiveness. A narrative review and hygienic analysis were conducted using public health principles and environmental hygiene standards. The results indicate that adequate air exchange significantly reduces carbon dioxide accumulation, excessive humidity, dust, microorganisms, and unpleasant odors. Effective ventilation improves comfort, cognitive performance, occupational productivity, and disease prevention. The study highlights the importance of monitoring air exchange rates, carbon dioxide concentrations, thermal conditions, and ventilation-system performance as core indicators of hygienic safety.

Keywords: ventilation, indoor air quality, microclimate, carbon dioxide, hygienic assessment, air exchange, environmental health.

Introduction

People spend approximately 80–90% of their time indoors, making indoor environmental quality a critical public-health issue. Poor ventilation contributes to the accumulation of pollutants, allergens, microorganisms, carbon dioxide, and moisture. In educational institutions, hospitals, offices, and residential buildings, inadequate air circulation may adversely affect concentration, productivity, respiratory health, and overall well-being. Modern environmental health research demonstrates that properly designed ventilation systems reduce exposure to airborne contaminants and help prevent infectious disease transmission. The objective of this study is to evaluate the hygienic significance of indoor ventilation systems and identify key indicators for assessing their effectiveness.

Materials and Methods

A descriptive and analytical review approach was applied. Scientific publications, environmental hygiene textbooks, and ventilation-related public-health recommendations were reviewed. The hygienic assessment framework included temperature, relative humidity, air velocity, air exchange rate, particulate contamination, and carbon dioxide concentration. Ventilation efficiency was evaluated through qualitative and quantitative indicators. Air exchange rate was estimated using K=L/V, where K is the air exchange frequency, L is airflow volume per hour, and V is room volume.

Results

Analysis demonstrated that both natural and mechanical ventilation contribute significantly to maintaining acceptable indoor air quality. Natural ventilation through windows and vents provides a low-cost method of air exchange but depends on weather conditions. Mechanical ventilation

provides controlled and predictable airflow and is particularly important in hospitals, laboratories, and production facilities. Rooms with effective ventilation demonstrate lower concentrations of carbon dioxide, reduced humidity, fewer odors, and lower microbial contamination. Carbon dioxide levels are especially useful as indicators of ventilation adequacy because concentration increases rapidly in overcrowded or poorly ventilated rooms. Adequate ventilation also supports thermal comfort and reduces risks associated with mold growth and airborne infection transmission.

Discussion

The findings confirm that ventilation effectiveness depends not only on supplying fresh air but also on removing contaminated indoor air. Contemporary public-health strategies emphasize ventilation as a preventive measure against respiratory illnesses and indoor environmental hazards. Excessive humidity promotes biological growth, while insufficient airflow contributes to pollutant accumulation. However, overly intensive airflow may create discomfort, drafts, and energy inefficiency. Therefore, ventilation design must consider occupancy levels, room function, pollutant sources, and climatic conditions. Continuous monitoring of microclimatic parameters allows optimization of indoor environmental conditions and protection of human health.

Ventilation is an essential hygienic measure for maintaining healthy indoor environments. Effective ventilation systems reduce carbon dioxide, moisture, dust, odors, and airborne contaminants while improving comfort and productivity. Hygienic assessment should include air exchange rate, temperature, humidity, airflow velocity, and carbon dioxide concentration. Properly designed and maintained ventilation systems contribute substantially to disease prevention and occupational health protection.

Table 1. Main Hygienic Indicators of Ventilation Assessment

Indicator	Importance	Hygienic Significance
Air exchange rate	Ventilation performance	Removal of contaminants
CO2 concentration	Occupancy indicator	Assessment of fresh-air supply
Relative humidity	Microclimate	Prevention of mold growth
Air velocity	Comfort	Thermal wellbeing

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